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Meltwater pathways and grain size transformation in a Pleistocene Mediterranean glacial-fluvial system

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The Pleistocene sedimentary records of Mount Orjen, western Montenegro, have been used to investigate changes in grain size characteristics of fine sediments transported from the glaciated mountains to the fluvial systems downstream. Understanding the particle size characteristics of the fine sediments transported by these cold stage river systems is important for several reasons. The braided rivers draining the glaciated mountains of the western Balkans may have been an important source of loess for example. It is also important to establish the grain size signature of suspended sediment delivered to the marine environment to aid land-marine correlations.

The fine-grained component of the tills is dominated by glacially-comminuted limestone particles. Detailed particle size analysis of the fine sediment matrix component (<63 μm) of glacial till and alluvial deposits has been undertaken using multiple samples at 12 sites surrounding the Orjen massif. This limestone karst terrain includes a range of meltwater pathways and depositional contexts, including: river valleys, alluvial fans, poljes, and ice marginal settings. 35 U-series ages and soil development indices have been used to develop a robust geochronology for the Pleistocene records

Two dominant surface meltwater and sediment pathways have been identified around Mount Orjen. The particle size distributions reveal that these transportation routes can have distinctive sedimentological signatures. Type 1 pathways deliver meltwater and sediments downstream via bedrock gorges. In these settings, the fine grained alluvial matrix presents a largely bimodal particle size distribution (PSD). Type 2 pathways represent meltwater channels draining directly from the ice margin. Alluvial sediments within these environments more closely resemble the normally distributed PSD of the glacial tills. The transition to bimodal PSDs, downstream of Type 1 meltwater routes, suggests that the glacially-comminuted sediments are modified in the fluvial environment. Significantly, the carbonate component is preferentially depleted or removed from the fine silt size fraction. Non-carbonate sediments are instead concentrated into this particle size window. This is thought to be a product of physical and chemical weathering as well as the mechanical sorting of glacially-derived limestone sediments. This has important implications for our understanding of sediment transfer processes within glaciated catchments before these sediments are transported offshore.